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Vinoth KN
Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Sasikala K
Department of Seed Science and Technology, Institute of Agriculture, TNAU, Kumulur, Tamil Nadu, India

Renganayaki PR
Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Vanitha K
Department of Crop physiology, Tamil Nadu Agricultural University, Coimbatore, India

Chandrakumar K
Department of Renewable Energy Engineering, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Corresponding Author:
Sasikala K
Department of Seed Science and Technology, Institute of Agriculture, TNAU, Kumulur, Tamil Nadu, India

Effect of crop management techniques to maximize seed yield attributes of sesame Cv. VRI2 & VRI3

Vinoth KN, Sasikala K, Renganayaki PR, Vanitha K and Chandrakumar K

Abstract
A Field experiment was conducted at the Department of seed science and technology, Tamil Nadu Agricultural University, Coimbatore during kharif 2019 to study the effect of crop management techniques to maximize seed yield attributes of sesame (*Sesamum indicum* L.) (2n =26). Because of the lower production and productivity of sesame due to its cultivation in rainfed & rice fallow areas of marginal and sub-marginal lands with poor management practices the study was undertaken with two nippings at terminal bud on different days of the crop i.e., 45th & 60th DAS followed by foliar application of different plant growth regulators in two varieties *viz*., VRI2 and VRI3. The experiment revealed that, nipping of sesame crop at 45th DAS followed by foliar spray with Brassinolide @ 0.5 ppm found to be the best crop management treatments to improve seed yield attributes of sesame in both varieties.

Keywords: Sesame, variety, nipping, foliar application

Introduction
Sesame (*Sesamum indicum* L.) belongs to Pedaliaceae family is one of the ancient oil seed crops of India. It is cultivated in almost all parts of the country in different seasons of the year (Bedigian and Harlan, 1986) for pungent and palatability. Sesame is grown in tropical to temperate regions of about 40°N latitude to 40°5' N latitude (Ashri, 1998) [1]. Sesame is an annual plant growing to a height 50 to 100cm (1.6 to 3.3 ft) tall with an opposite leaves of 4 to 14 cm length (1.6 to 5.5 inch) throughout the entire margin; they are broad lanceolate and 5cm (2 inch) broad at the base of the plant. The flowers may vary in colour of white, blue or purple also sesame seeds are in different colours depending on the cultivars.
Sesame is basically a short-day plant. Sesame seed is an important source of edible oil and contains 18-25 per cent protein. A source of excellent vegetable oil, sesame is one of the highest oil content of 35–63% (Ashri, 1998; Baydar *et al*., 1999) [1, 4]. The oil is very stable due to presence of number of antioxidants such as sesamin, sesamolin and sesamol (Suja *et al*., 2004) [21]. Therefore, it has a long shelf life and can be blended with less stable vegetable oils to improve their stability and longevity (Chung *et al*.,2004; Suja *et al*., 2004) [5, 21]. Recent studies have shown that the oil lowers cholesterol levels and hypertension in humans (Lemcke-Norojarvi *et al*., 2001) [13], and reduces the incidence of certain cancers (Hibasami *et al*., 2000) [6]. The observed effects have been attributed to the chemical composition of the oil, characterized by a low level of saturated fatty acids and the presence of antioxidants. Oil is pale yellow in colour containing 1-2 per cent Ca, P, vitamin niacin, amino acids methionine and tryptophan. Apart from this, sesame is used as edible oil, pharmaceuticals, perfumery, cosmetics and soap industry. Oil has pleasant odour and taste.
In 2016 India ranks first in area 18.93 lakh hectare followed by Myanmar and Nigeria. Production of sesame seeds was 8.02 lakh tonnes and the average productivity of sesame 448 kg/ha in India. The black and darker coloured sesame seeds are mostly produced in china and south east Asia. The productivity of sesame has been decreasing in India due to growing the crop in uncared rainfed area and in rice fallow field using 60% residual soil moisture, not much attention has given for applying fertilizer, pesticides, fungicides and irrigation led to poor harvest index, seed shattering and ill filled pods. In addition, improvement of sesame has been slow due to lack of adequate research and efficient breeding programs (Ashri,1998) [1]. To overcome this strategy, the field experiment was conducted with crop management techniques to maximize the seed yield attributes of sesame cv. VRI2 & VRI3.

Materials and Methods

A field experiment was conducted at the Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore, Tamilnadu-641 003 during Kharif 2019 to study the effect of crop management techniques to maximize the seed yield attributes of sesame cv. VRI2 and VRI3. The experiment was laid out in Factorial Randomized Block Design (FRBD) (Rangaswamy, 2002) [20] with two replications, two varieties, two nippings and five foliar treatments with control.

Variety

V_1- VRI2 (Black seed)
V_2- VRI3 (White seed)

Treatments

Nipping Treatments

N_0 - Control (No Nipping)
N_1 - Nipping at 45 DAS
N_2 - Nipping at 60 DAS
*DAS – Days after sowing

Foliar Treatments

T_0 - Control (No Spray)
T_1- Foliar spray with Benzyl Amino Purine @ 30 ppm
T_2- Foliar spray with Brassinolide @ 0.5 ppm
T_3- Foliar spray with Triacontanol @o100 ppm
T_4- Foliar spray with Salicylic acid @ 100 ppm
T_5- Foliar spray with Zinc sulphate @ 0.5% conc.

The crop was raised during Monsoon season of July to October, 2019 in line sowing at a spacing of 22.5 cm x 22.5 cm with seeds mixed with sand in a ratio of 1:4 by its seed volume. Normal cultural practices were done with recommended fertilizer dose of NPK @ 35:23:23 kg/ha, the entire doses of phosphorous & potassium and half dose of nitrogen were given as basal at sowing time and remaining half dose of nitrogen was applied as top dressing after the first hand weeding. On 7th day after sowing the crop was gap filled and then thinning was done at 20 and 25 days after sowing and maintained a proper plant population.

Nipping of terminal bud was done on 45th & 60th DAS and followed by different foliar sprays on the same day of nipping treatments. Observations were taken on plant height (cm), number of capsules per plant, number of seeds per capsule, and seed yield (kg/ha) at harvest stage and data analysed using FRBD statistical design.

Results and Discussion

Sesame is one of the important oil seed crop having more unsaturated oil, antioxidants and involved in pharmaceuticals, culinary uses its been called as "Queen of oil seeds". The productivity of sesame has been decreasing in India due to growing the crop in uncared rainfed area, maximum the crop is being raised as rice fallow crop using 60% available residual soil moisture after rice, not much attention is given to fertilize & irrigate the crop. Due to poor caring of crop ultimately led to low grain yield, susceptibility to pests and diseases, low harvest index, seed shattering and more ill filled pods. Based on this problem the study was carried out with two nippings at terminal bud on different days of the crop i.e., 45th & 60th DAS followed by foliar application of different plant growth regulators in two varieties *viz*., VRI2 and VRI3. The results were statistically significant in plant height, number of capsules per plant, number of seeds per capsule and seed yield.

Between varieties V_1 (VRI2) (103.5 cm) recorded 5.2% increase in plant height than V_2 (VRI3) (98.3 cm) due to the tolerance of crop against biotic and abiotic stress. Among nippings, removal of apical bud on 45th DAS (N_1) (108.8 cm) was significantly superior to N_2 (103.2 cm) and N_0 (90.2 cm) recorded 5.4% & 20% increase in plant height respectively since nipping at early stage of the crop on 45th DAS activated dormant lateral buds vigoursly and energy were diverted for increasing the height of the axillary branches. Though all the treatments recorded significantly more plant height than control (To) foliar treatment with Brassinolide (T_2) (107.1cm) was significantly superior to other treatments & control recorded 35.5% increase in plant height than T_0 (84.5 cm) which compensated the stress created by pinching. In V_1 (VRI2) maximum plant height was recorded in N_1T_2 (132.7 cm) and also the same treatment N_1T_2 performed better in V_2 (Table 1). Robredo *et al.*, (2007) [19] reported that increased plant height by foliar application induced the physiological process. The increased plant height in early nipping of apical bud on 45th DAS might have triggered cell division and cell elongation and thereby boosted uplifting of plant growth to a higher level. Cutting the plants increased the amount of nitrogen and other essential elements and in turn increased the production of carbohydrates for the reproductive phase (Mathew and Karikari, 1995).

Table 1: Effect of variety, nipping and foliar treatment on Plant height (cm) of sesame

Variety	VRI2 (V_1)				VRI3 (V_2)				MEAN
Foliar \ Nipping	N_0	N_1	N_2	Mean	N_0	N_1	N_2	Mean	
T_O	84.0	89.0	85.5	86.2	80.6	85.7	82.0	82.8	84.5
T_1	94.3	120.3	117.3	110.7	92.0	112.0	106.4	103.5	107.1
T_2	98.3	132.7	124.0	118.3	96.0	123.5	112.2	110.6	114.5
T_3	92.4	114.9	109.7	105.7	91.4	108.0	101.7	100.3	103.0
T_4	92.0	110.0	106.0	102.7	90.1	105.9	97.7	97.9	100.3
T_5	90.7	103.0	98.4	97.4	87.0	100.0	97.3	94.8	96.1
Mean	92.0	111.7	106.8	103.5	89.5	105.9	99.5	98.3	100.9
	V	N	T	V x N	N x T	V x T	VxNxT		
SEd	0.014	0.018	0.025	0.025	0.043	0.035	0.061		
CD(p=0.05)	0.029	0.035	0.050	0.050	0.087	0.071	0.122		

V x N Interactions

Variety	VRI2 (V_1)				VRI3 (V_2)			
Nipping	N_0	N_1	N_2	Mean	N_0	N_1	N_2	Mean
Mean	92.0	111.7	106.8	103.5	89.5	105.9	99.5	98.3

V xT Interactions

Foliar \ Variety	V_1	V_2	Mean
T_O	86.2	82.8	84.5
T_1	110.7	103.5	107.1
T_2	118.3	110.6	114.5
T_3	105.7	100.3	103.0
T_4	102.7	97.9	100.3
T_5	97.4	94.8	96.1
Mean	103.5	98.3	100.9
	V	T	V x T
SEd	0.014	0.025	0.035
CD(p=0.05)	0.029	0.050	0.071

N x T Interactions

Foliar \ Nipping	N_0	N_1	N_2	Mean
T_O	82.3	87.3	83.8	84.5
T_1	93.2	116.2	111.9	107.1
T_2	97.2	128.1	118.1	114.5
T_3	91.9	111.5	105.7	103.0
T_4	91.1	108.0	101.8	100.3
T_5	88.8	101.5	97.9	96.1
Mean	90.7	108.8	103.2	100.9
	N	T	N x T	
SEd	0.018	0.025	0.043	
CD(p=0.05)	0.035	0.050	0.087	

The number of capsules per plant was highly significantly differ in varieties, nipping, treatments, and their interactions. Between the varieties V_1 (VRI2) (111) recorded 7.7% increased number of capsules per plant significantly superior to V_2 (VRI3) (103). Irrespective of varieties & foliar treatments both nipping N_1 (115) and N2 (108) were performed better than control (N_0) (98), however, N_1 recorded 17.3% increase in number of capsules per plant than N_0 (98). Irrespective of varieties and nippings, the foliar treatment Brassinolide (T_2) (113) was significantly superior to other treatments and control recorded 23.4% increase in number of capsules per plant than T_0 (98). With respect to their interactions V_1 (N_1T_2) (136) recorded the maximum number of capsules per plant than other treatments and control (Table 2). Increased in number of capsules per plant was due to nipping apical bud and stress created by nipping was compensated by application of Brassinolide which stimulated the lateral branches and produced more number of side branches might be induced the synthesis of both Gibberallic acid and Indole acetic acid in plant body which increase the number of capsules in all branches than other treatments. This is also reported by Kathiresan & Duraisamy (2001) [10] and Arul (2014) [2] in daincha and vasanthan (2019) [23] in sesame. Kamal *et al*. (1995) [12] reported that Brassinolide application increased the seed and pod numbers in soybean.

Table 2: Effect of variety, nipping and foliar treatment on Number of capsules/plant of sesame

Variety	VRI2 (V_1)				VRI3 (V_2)				MEAN
Foliar \ Nipping	N_0	N_1	N_2	Mean	N_0	N_1	N_2	Mean	
T_O	96	102	98	99	90	101	99	96	98
T_1	111	122	120	118	94	119	114	109	113
T_2	120	136	125	127	96	128	121	115	121
T_3	108	119	111	113	90	117	102	103	108
T_4	102	112	104	106	88	111	99	99	103
T_5	103	110	105	106	84	108	98	96	101
Mean	107	117	110	111	90	114	105	103	107
	V	N	T	V x N	N x T	V x T	VxNxT		
SEd	0.013	0.016	0.023	0.023	0.040	0.033	0.057		
CD(p=0.05)	0.027	0.033	0.046	0.046	0.080	0.066	0.114		

V x N Interactions

Variety	VRI2 (V_1)				VRI3 (V_2)			
Nipping	N_0	N_1	N_2	Mean	N_0	N_1	N_2	Mean
Mean	107	117	110	111	90	114	105	103

V x T Interactions

Foliar \ Variety	V_1	V_2	Mean
T_O	99	96	98
T_1	118	109	113
T_2	127	115	121
T_3	113	103	108
T_4	106	99	103
T_5	106	96	101
Mean	111	103	107
	V	T	V x T
SEd	0.013	0.023	0.033
CD(p=0.05)	0.027	0.046	0.066

N x T Interactions

Foliar \ Nipping	N_0	N_1	N_2	Mean
T_O	93	101	99	98
T_1	103	121	117	113
T_2	108	132	123	121
T_3	99	118	107	108
T_4	95	111	102	103
T_5	93	109	101	101
Mean	98	115	108	107
	N	T	N x T	
SEd	0.016	0.023	0.040	
CD(p=0.05)	0.033	0.046	0.080	

The number of seeds per capsule was significantly more in V_2 (VRI3) compared to V_1 (VRI2) recorded 14.5% increase in number of seeds per capsule in V_2 (VRI3) (79). Irrespective of varieties & foliar treatments among nippings N_2 (78) recorded 6.8% & 9.8% increased number of seeds per capsule than N_1 (73) and N_0 (71) respectively. Irrespective of varieties and nipping, the foliar treatment Brassinolide (T_2) (80) was superior to other treatments and control and recorded 15.9% more number of seeds per capsule than T_0 (69). With respect to their interactions in V_2, combination of N_2T_2 (89) recorded the maximum number of capsules per plant (Table 3). Removal of apical buds at the later stages increased the dry matter accumulation in okra (Olasantan, 1986) [16] which increasing translocation of assimilates from source to sink. Singh and Singh (1992) [22] stated that pinching of apical portion of buds at 60, 75 and 90 DAS the energy was utilized for production of more number of branches and increases the pod formation in pea.

Table 3: Effect of variety, nipping and foliar treatment on Number of seeds/ capsule of sesame

Variety	VRI2 (V_1)				VRI3 (V_2)				Mean
Foliar \ Nipping	N_0	N_1	N_2	Mean	N_0	N_1	N_2	Mean	
T_O	62	64	66	64	72	74	77	74	69
T_1	69	72	79	73	76	79	86	81	77
T_2	71	78	82	77	79	80	89	83	80
T_3	67	66	71	68	75	77	86	79	74
T_4	65	63	69	66	74	78	82	78	72
T_5	65	64	67	65	75	78	85	79	72
Mean	66	68	72	69	75	78	84	79	74
	V	N	T	V x N	N x T	V x T	VxNxT		
SEd	0.014	0.017	0.024	0.024	0.041	0.034	0.059		
CD(p=0.05)	0.028	0.034	0.048	0.048	0.083	0.068	0.117		

V x N Interactions

Variety	VRI2 (V_1)				VRI3 (V_2)			
Nipping	N_0	N_1	N_2	Mean	N_0	N_1	N_2	Mean
Mean	66	68	72	69	75	78	84	79

V x T Interactions

Foliar \ Variety	V_1	V_2	Mean
T_O	64	74	69
T_1	73	81	77
T_2	77	83	80
T_3	68	79	74
T_4	66	78	72
T_5	65	79	72
Mean	69	79	74
	V	T	V x T
SEd	0.014	0.024	0.034
CD(p=0.05)	0.028	0.048	0.068

N x T Interactions

Foliar \ Nipping	N_0	N_1	N_2	Mean
T_O	67	69	72	69
T_1	73	75	83	77
T_2	75	79	86	80
T_3	71	72	78	74
T_4	70	70	75	72
T_5	70	71	76	72
Mean	71	73	78	74
	N	T	N x T	
SEd	0.017	0.024	0.041	
CD(p=0.05)	0.034	0.048	0.083	

The seed yield was maximum in V_1 (VRI2) (714.1 kg/ha) recorded 3.5% increased yield than V_2 (VRI) (689.9 kg/ha). Irrespective of varieties & foliar treatments among nippings N_1 (45th DAS) (716.5 kg/ha) recorded maximum seed yield than N_2 and N_0. Irrespective of varieties and nipping, the foliar treatment Brassinolide (T_2) recorded maximum seed yield of 712.7 kg/ha which was 8% increase in yield than T_0 (668.4 kg). In overall N_1T_2 recorded the highest seed yield of 758.9 kg in V_1 (VRI2) which was significantly superior to other treatments and lowest was recorded by control (Table 4). The increase in yield due to the application of Homobrassinolide (HBR) and Epibrassinolide (EBR) was in consonance with the findings of Ikekawa and Zhao (1991) [8] and also confirmed by vasanthen *et al.*,(2019) [23].

Table 4: Effect of variety, nipping and foliar treatment on seed yield (kg/ha) of sesame

Variety	VRI2 (V_1)				VRI3 (V_2)				MEAN
Foliar \ Nipping	N_0	N_1	N_2	Mean	N_0	N_1	N_2	Mean	
T_O	680.8	688.7	684.1	684.5	650.2	655.2	651.4	652.3	668.4
T_1	700.3	743.4	737.0	726.9	663.2	720.5	711.7	698.5	712.7
T_2	708.4	758.9	742.4	736.6	671.9	729.2	720.4	707.2	721.9
T_3	695.6	728.5	724.8	716.3	660.9	713.7	712.1	695.5	705.9
T_4	695.5	724.8	721.6	714.0	658.8	712.3	711.4	694.2	704.1
T_5	691.7	713.8	713.9	706.5	659.0	708.6	708.3	692.0	699.2
Mean	695.4	726.3	720.6	714.1	660.7	706.6	702.6	689.9	702.0
	V	N	T	V x N	N x T	V x T	VxNxT		
SEd	0.454	0.556	0.787	0.787	1.363	1.113	1.927		
CD(p=0.05)	0.906	1.109	1.569	1.569	2.718	2.219	3.843		

V x N Interactions

Variety	VRI2 (V_1)				VRI3 (V_2)			
Nipping	N_0	N_1	N_2	Mean	N_0	N_1	N_2	Mean
Mean	695.4	726.3	720.6	714.1	660.7	706.6	702.6	689.9

V xT Interactions

Foliar \ Variety	V_1	V_2	Mean
T_O	684.5	652.3	668.4
T_1	726.9	698.5	712.7
T_2	736.6	707.2	721.9
T_3	716.3	695.5	705.9
T_4	714.0	694.2	704.1
T_5	706.5	692.0	699.2
Mean	714.1	689.9	702.0
	V	T	V x T
SEd	0.454	0.787	1.113
CD(p=0.05)	0.906	1.569	2.219

N x T Interactions

Foliar \ Nipping	N_0	N_1	N_2	Mean
T_O	665.5	671.9	667.7	668.4
T_1	681.7	732.0	724.4	712.7
T_2	690.2	744.1	731.4	721.9
T_3	678.3	721.1	718.4	705.9
T_4	677.1	718.6	716.5	704.1
T_5	675.3	711.2	711.1	699.2
Mean	678.0	716.5	711.6	702.0
	N	T	N x T	
SEd	0.556	0.787	1.363	
CD(p=0.05)	1.109	1.569	2.718	

Conclusion

This experiment concluded that nipping of apical bud at 45th DAS followed by foliar spray with Brassinolide @ 0.50 ppm was found to be the best crop management techniques to maximize seed yield of sesame cv. VRI2 & VRI3 during kharif season.

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